BEYOND LINEARITY

Dear Editors:

IN A RECENT Forum article, Patterson provides convincing scientific evidence for a re-examination of the linear no-threshold (LNT) model in setting standards for radiation protection (Patterson 1997). However, the LNT debate goes beyond science.

Economic considerations also provide a forceful argument. Regulatory compliance costs too much. The LNT model is used widely to predict the reduction in risk for a given reduction in dose. However, there is little epidemiological evidence to show that reducing exposure to ionizing radiation leads to a reduction in health risk. Regulations aimed at reducing occupational safety and health risks have imposed compliance costs of over $9 billion annually for negligible risk-reduction benefits (Hahn and Hird 1991).

Perhaps public relations fallout is the most compelling reason to re-examine LNT. Support of the LNT theory and the idea that any radiation dose is potentially harmful has resulted in a public relations nightmare for the nuclear industries (including medical applications of radiation). Unwavering support of the LNT theory has made it almost impossible to respond effectively to alarmists' claims that any dose of radiation is dangerous. Public "outrage" from dangerous radiation has led to over-regulation of nuclear industries resulting in billions of dollars in compliance costs.

Opponents of the LNT model need to move the debate beyond scientific arguments. If the LNT model is unacceptable, what should be the basis for standards setting? Alternative models (e.g., quadratic, linear-quadratic and threshold models) to predict risk at low dose may prove to be equally unacceptable. All biologically plausible predictive models have significant uncertainties and cannot be readily distinguished from one another in the low dose range. Perhaps consideration should be given to model-independent strategies to set standards. One possible strategy involves a dosimetric approach. Exposure limits might be based on the average natural background level to the U.S. population (~3 mSv y^{-1}). Epidemiological studies of populations around the world exposed to background levels several times the U.S. average have not detected an increase in health effects due to natural background radiation (NAS 1990). Another strategy is based on an epidemiological approach. After more than 50 years of epidemiological observations, 100 mSv is the lowest dose which has been consistently associated with a statistically significant radiogenic risk. Using 100 mSv as a lifetime (70 y) dose limit and correcting for the lower dose rate associated with environmental exposures (DREF = 2), a public exposure limit of 2–3 mSv y^{-1} is calculated. These are simple, straightforward methods to establish public exposure limits. Such methods are rational and may be readily explained to the public.

KENNETH L. MOSSMAN

Arizona State University
Box 872701
Tempe, *AZ* 85287-2701

References

Hahn, R. W.; Hird, J. A. The costs and benefits of regulation: Review and synthesis. Yale J. on Regulations 8:233–278; 1991.

National Academy of Sciences. Health Effects of Exposure to Low Levels of Ionizing Radiation BEIR V Report. Washington DC: National Academy Press; 1990.

Patterson, H. W. Setting standards for radiation protection: The process appraised. Health Phys. 72:450–457; 1997.

RESPONSE TO MOSSMAN

Dear Editors:

MOSSMAN correctly points out that the process for setting standards for radiation protection goes beyond science. He mentions economics and public perception as other ingredients; and we all know this to be true.

However, in my view, the standard setting process must first be scientifically based on a consideration of all pertinent data on human exposure to radiation. Unfortunately, as my Forum article shows, this is not now the case.

Standard setting groups have selected, manipulated and even overlooked human data, simply to conform to an assumptionfor which scientific evidence is scanty at best. This practice is common, and in my Forum article I was able to give only a few of many examples.

Nowhere, to my knowledge, have standards been set using a "best fit" to the data. Instead they are based on a scientifically unjustified downward extrapolation using a risk-response curve whose origin is either at 0.0 (absolute risk model) or at 1.0 (relative risk model), and whose slope is everywhere positive. This procedure guarantees that all derived risks will be positive.

First, give proper scientific scrutiny to all the data; second, come to scientific consensus on what the data have to say about human response to radiation exposure; only then consider other factors which bear on the standards themselves.

H. WADE PATTERSON

1116 *Linda Lane*
Lakeview, *OR* 97630

0017-9078/97/$3.00/0